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hands of the principal librarian of the British museum to the newly appointed superintendent, who is styled director. The names of the keepers of the several sections are so well known as scarcely to need repetition. The staff, as now constituted, is as follows:—

Prof. W. H. Flower, director; Dr. Albert Günther, keeper of zoölogy; Arthur G. Butler, Esq., assistant keeper of zoölogy; Dr. H. Woodward, keeper of geology; R. Etheridge, Esq., assistant keeper of geology; L. Fletcher, Esq., keeper of mineralogy; W. Carruthers, keeper of botany. FREDERICK W. TRUE.

*VEGETABLE MORPHOLOGY A CENTURY AGO.—GOETHE.*

In a previous article we have seen the conclusions reached in matters morphological by Linné and his contemporaries. Thirty years from the time of Wolff and Linné had passed away, when the appearance of Goethe's treatise on metamorphosis gave to the world once for all the true solution of Nature's problem, and, as becomes more and more apparent, determined for the nineteenth century the trend of its scientific thought. Goethe approached and stated the whole question anew; worked it out in his own persistent way; set forth with clearness the truths dimly hinted by Linné, by Wolff vainly declared; and by the splendor of his genius, and his attainments in matters purely literary, compelled the recognition of the world.

Goethe's discovery was a wonder to men of his day, is a wonder still. It is thought that the truth came to him by strange intuition, by special inspiration of some mysterious sort. His mind so surpassed that of ordinary men of talent that to his clear vision nought but truth appeared; as to a Newton, the propositions of simple geometry came without necessity of proof. But such was by no means Goethe's experience. Surely his imaginative genius suggested the idea involved; but the exposition of his theory came after months of laborious investigation, and observations repeated again and again. Furthermore, while the result proves that he made a most 'scientific use' of his imagination, it is also apparent that the poetic use of that faculty is never quite absent from his work. If his testing by observation the suggestions of his imagination is scientific, his fondness for generalization, his instinctive conviction of the unity of natural forms, and many of the details of his theory, are poetic in the extreme.

Goethe wrote of metamorphosis. The term 'morphology' does not appear in his writings until 1807. He uses the former word, however, to denote, not the actual conversion of any one organ into any other, but simply the correspondence of all organs discussed to one and the same ideal type.

In setting forth his theory, Goethe begins with the cotyledons, and shows them to be leaves after their fashion, differing in form from the ordinary leaf of the plant as they differ in function. He also notices that the first true leaves put forth are likewise not perfect, but are usually much narrower and simpler every way than those that follow. Goethe believes that the varying form of the leaf is due to variable nourishment. He regards the sap which nourishes these early leaves as very crude and poor indeed. He observes that the successive nodes of the stem receive each its sap through the medium of those below, and so each receives and furnishes to leaf and bud purer and more refined juices. Further, while the more imperfect fluids are constantly discarded, the purer are as continually assimilated and used, until Nature reaches her prescribed limits of growth: the leaves attain their greatest extent and perfection in development, and all is prepared for a new phenomenon.

Linné had shown that abundant bloom comes from scant nourishment. Goethe reasserts this, and argues, that, so long as raw material is to be disposed of, so long must all possible organs of the plant be converted into tools for the purpose. If too much nourishment is provided, the condition of blooming becomes impossible. Withdraw the nutrition, the organs of the node become more refined; the elaboration of juices unadulterated, purer and more refined takes place; the metamorphosis of the parts becomes possible, and forthwith ensues. When, in the light of present knowledge, we reflect upon the cost at which any plant puts forth its bloom, these century-old surmises of the poet seem to acquire new meaning and most peculiar interest.

In Goethe's time the involucrum of a composite flower was still regarded as calyx, and accordingly the gradation from bracts to sepals was easy enough. This mistake does not, however, vitiate the poet's argument on this point; for he asserts the same transition in other plants, and cites the Compositae simply as affording the most patent illustration. He argues with perfect clearness, that the assembling about one point of several leaves, nay, even of several nodes, is not strange, as the same thing may be meeting every plumule. The

union of these narrowed sepal-leaves in the monopetalous calyx is induced by the highly refined sap circulating in a part of the plant so distal, so remote. "In the calyx, Nature produces nothing new. She simply unites and changes parts already familiar, and so rises by one step nearer her destination."

Now, as the calyx owes its character to the refinements of organs preceding it, so it in turn becomes an organ of filtration; and from the crowded vessels of the sepal comes the pure liquid which makes possible the petal. Colored petals indicate that the nourishing fluid has reached a high degree of refinement, white, of absolute purity. The equivalency of sepal and petal is shown by the usual comparison, Goethe adding only that as the sepal evinces contraction, so does the petal expansion, and we are thus prepared for the last degree of contraction in the formation of the stamen. The foliar nature of the latter organ, as of the carpels, is shown in the familiar way. The petaloid style of the iris is cited, as also the reversion so common among crowfoots, tulips, etc.

But it is to the nectary (a very comprehensive term in Goethe's time) that the poet here gives chief attention. Nectaries seem to occupy an intermediate place between stamens and petals, now partaking of the character of one organ, now of the other. Goethe inclines to the opinion that nectaries are undeveloped stamens. He is certain, at least, that the nectar itself is concerned in the fertilization of the flower; for, "after fertilization, the nectar disappears, and no more is formed." He conceived that the nectar might be an imperfect fertilizing fluid; that the pollen-grains are so many minute vesicles containing an exceedingly delicate matter elaborated by the vessels of the stamen, and destined to be absorbed by the pistil.

Think of all this in view of the modern doctrine of fertilization and cross-fertilization, and you begin to appreciate the inventive genius of the man, hovering about his subject, and almost divining that which he could not clearly see, and then his conclusion: "The forms of plants about us are not originally determined and invariably fixed, but unite with some persistence of generic, specific, and individual character, a fortunate power to vary and to accommodate themselves to circumstances, so as to be able to meet and adapt themselves to the varying conditions which come upon the earth." Darwin might have written it: Darwin could have said no more.

Such is a brief outline of Goethe's contribu-

tion to botanical science. The importance of his discovery can scarce be over-estimated, while its beauty can be appreciated only after careful examination, not only of the discovery itself, but likewise of the manner of its attainment. As to the latter, we are happily not left in doubt. The poet has himself given us a concise account of every step of his progress. We may see the impassioned enthusiasm of Linné stimulating society universal, so that Goethe says it fairly 'floated him along.' What an era in which to live, — the very springtime of science, the air redolent of odors of the life to be! Even petulant, passionate Rousseau forgets for the nonce his dreams of social compact, and, charmed with the beauty of the living world, becomes botanist, and even begins a botanical dictionary. The spirit of investigation was abroad, and Goethe entered his morphological studies with all the energy of his nature. His ideas took possession of him. The voice of Nature cried: he could not choose but hear. His work became a passion, a *leidenschaft* he calls it, from which even the marbles of Italy and the palaces of the 'eternal city' could not divert him. He was a poet; but he suddenly found out that Nature, too, is poetic, and that even her most gifted child has nothing that he has not received, nor has so much that he may not crave and receive the more. The facts of Nature were before him: his thought responded to the thought in Nature. It seemed as if it were so. It must be so. It was so.

It is said that each individual lives in epitome the life-history of his race. May it not be said that in this brief sketch of the rise of a single scientific doctrine we have found those agencies which make possible all and every science, — the light of the eye, the light of the intellect, and the vivid brilliancy of the imagination, — Linné, Wolff, Goethe, — the systematist, the student, and the poet?

T. H. McBRIDE.

#### *AN ATTEMPT TO PHOTOGRAPH THE SOLAR CORONA WITHOUT AN ECLIPSE.*

Since writing my last communication on this subject, I have made a series of investigations with the object of improving my apparatus, if possible, and of obtaining some quantitative measurements of the light reflected by the atmosphere near the sun. To avoid the reflection of the light from the surfaces of the glass, I removed my achromatic lens, and substituted for it a simple spectacle-glass of one and three-eighths inches diameter, and forty-nine inches focus. As the diameter was relatively so small, the